Phoenix Framework
for Integrated Air Quality Assessment and Policy Analysis

EPA Science Forum 2004
Healthy Communities and Ecosystems

Regulatory Impact Assessment | Benefit-Cost Analysis | Climate Change Air Quality Assessment

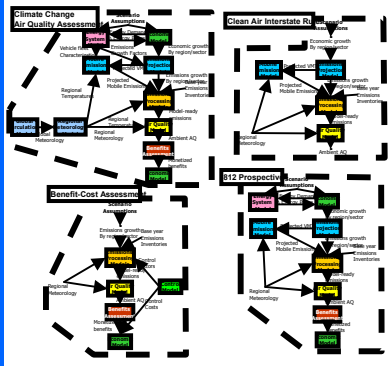
Model Evaluation | Multimedia Impact Analysis | What-If Investigation | Decision Support System | High Performance Computing | Scenario Analysis | Integrated Modeling | Alternative Generation | Optimization | Sensitivity & Uncertainty Analysis | Policy Development | State Implementation Plan |

The Phoenix Framework for Integrated Air Quality Assessment and Policy Analysis is a customizable computer software package that is being developed by the EPA's Office of Air Quality Planning and Standards (OAQPS) and Office of Research and Development (ORD) to facilitate air quality research and policy analysis activities. This flexible modeling framework supports integration of energy, economic, emissions, air quality, and benefits models, and can be customized to meet the needs of specific EPA and external activities.

Background

EPA Assessments Involving Air Quality Modeling

Common characteristics:
- Similar models, databases, and linkages
- Multi-disciplinary, multi-model
- Cross-platform (e.g., PC & Linux computers required)
- Desire to conduct optimization and characterize uncertainty



Current Modeling Paradigm

Assessments often carried out by different groups at EPA
Many of the models making up each assessment are setup and operated by different parties
The focus of each party is on their individual component
Results are passed from one group to another

Potential Difficulties

Time and coordination requirements
Lack of transparency and consistency of assumptions across models
Replication
Logistical issues associated with:
- data management and transfer,
- incompatibility of file formats and model inputs and outputs
- consideration of modeling feedbacks
- integrated sensitivity and uncertainty analyses and optimization across the modeling components

Approach

Alternative, Integrated Modeling Paradigm

Explicitly define:
- modeling components
- models used for each activity
- model-specific assumptions
- linkages between models
- scenario assumptions and how these affect each model

Represent the integrated system within an integrated modeling framework
Modeling groups at EPA develop and configure their models for integration into the framework and specify the modeling parameters to which various end-users will have access
End-Users use the framework to:
- automate and monitor model execution
- manage data, store and organize modeling runs
- facilitate cross-platform operations
- visualize and statistically analyze results
- enable sensitivity analysis, uncertainty analysis, optimization, model comparison, calibration, consideration of feedbacks, etc.

Leveraging Agency Tools

Cost-effectively realize this integrated modeling paradigm by leveraging Agency and open-source modeling tools.

Phoenix is based upon EPA's Multi-Media Integrated Modeling System (MIMS) Framework, which:
- has been developed by ORD (NERL)
- is open-source, Java software
- facilitates model linkage and execution
- is highly extensible and customizable
- provides tools for cross-platform execution, uncertainty analysis, visualization, scenario and data management, etc.

Phoenix extends MIMS by incorporating:
- A generalized, high-level model focused on representing the functions and linkages among air quality and other relevant models
- Customization of the generalized model and available analysis tools for a particular application
- Packaging via custom graphical user interfaces and functionality to meet end-user needs

Goals and Objectives

- Provide an explicit representation of air quality modeling activities and their linkages
- Serve as a modeling framework that can be customized to meet client needs
- Facilitate the evaluation and comparison of air quality modeling scenarios
- Facilitate calibration, optimization, and uncertainty analysis
- Improve the transparency, consistency, and replication of Agency modeling projects
- Improve the ability of Agency modeling projects to leverage each others experiences and models
- Reduce the time and resources associated with assessments involving air quality modeling

PHOENIX
Framework for Integrated Air Quality Assessment and Policy Analysis

Potential Future Uses

ORD Climate Change Air Quality Assessment
- Evaluating linkages between climate change and criteria air pollutant concentrations

OAQPS Regulatory Impact Analysis and Benefits Assessment of the Particulate Matter and Ozone National Ambient Air Quality Standards (PM & O3 NAAQS)
- Evaluating the effects of control scenarios on air quality, health

Future Clean Air Act Cost-Benefit Analyses
- Evaluating the costs and benefits of the Clean Air Act and its Amendments (CAAA)

Integrated Modeling Across Media
- Evaluating the effects of pollutant and nutrient deposition on water quality

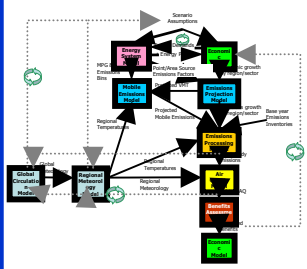
State Implementation Plan Modeling Efforts
- Evaluating compliance with CAAA requirements

Academic Modeling Efforts

Implementation

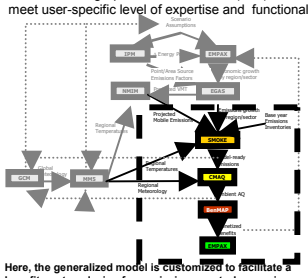
Step #1: Develop Generalized Model

The generalized model captures common modeling activities, linkages, and potential feedbacks.



Step #2 Customize the Generalized Model for the Specific Application

- Determine bounds and input assumptions
- Implement models for each modeling activity
- Add any additional models to meet assessment objectives
- Create model-specific input/output processors if necessary
- Customize the graphical user interface (GUI) to meet user-specific level of expertise and functionality



Here, the generalized model is customized to facilitate a benefit-cost analysis of an emissions control scenario

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Application

Example: Decision Support System for Evaluating the PM NAAQS
Target User: OAQPS's Innovative Strategies and Economics Group
Future Functionality: Use optimization with screening models to identify cost-effective control policies

The graphical user interface (GUI) design supports common use-cases

A setup wizard simplifies complex model configuration steps and provides the user with scenario development and policy options

The GUI facilitates model execution and monitoring, as well as access to model outputs and reports

Viewers and analysis tools are automatically invoked when outputs are selected